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TOURISM AND FOREST FIRES: PROBLEMS, CHALLENGES AND POSSIBILITIES

Milan Milenković[22], Jasna Micić[23], Stefan Denda[24]

Abstract: *Forest fires represent a serious threat to the tourism industry. In Europe, Portugal is most vulnerable to fire, followed by the Mediterranean countries. In the period 1980-2018, an average of 18,025 fires was recorded in Portugal, while the average annual burned area was 116,894 ha. The trend of the number of fires is increasing (statistically significant at p≤0.01). During 2017, fires affected 540,630 ha in Portugal, accounting for about 5.9% of the state territory. Statistically significant (p≤0.01) downward trends were found for Spain (burned areas), France (burned areas) and Italy (both parameters). The downward trends identified for Greece were not statistically significant. Natural conditions conducive to the occurrence and spread of fires in the Mediterranean area are dry periods during the summer, dry land without watercourses, and vegetation that is extremely vulnerable to fire. In these countries, the major tourist and fire seasons almost coincide. Forest fires endanger human lives, as well as tourism infrastructure and suprastructure, and contribute to creating a negative public image of a tourist destination. Future research should pay attention to improving the prognosis of forest fires.*

Keywords: *tourism, forest fires, Europe, Mediterranean, Portugal.*

Introduction

Tourism is vulnerable both to human and natural induced risks. Human-induced risks are wars, terrorism, political instability, and crimes, while natural-based risks include natural disasters (earthquakes, eruptions, tsunamis, forest fires, etc.), food and water quality, infectious diseases. Even thou the effects of natural disasters are shorter than human-induces, the damage to the tourism industry can be severe (Timothy, 2006).

Many of these events could not be accurately predicted but every destination should develop relevant risk management strategies (Murphy & Bayley, 1989). George (2003) defined three possible sceneries in the destination decision-making process, considering destination that is perceived as risky – potential tourist may decide not to visit destination characterized as highly risky; they will not participate in the activities out of the hotel resorts and tourist that felt unsafe on the vacation,

[22] Milan Milenković, PhD, Research Associate, Geographical Institute "Jovan Cvijić", Serbian Academy of Sciences and Arts, Djure Jakšića 9, 11000 Belgrade, Serbia, m.milenkovic@gi.sanu.ac.rs, +381 11 2636594
[23] Jasna Micić, MSc, Research Assistant, Geographical Institute "Jovan Cvijić", Serbian Academy of Sciences and Arts, Djure Jakšića 9, 11000 Belgrade, Serbia, j.micic@gi.sanu.ac.rs, +381 11 2636594
[24] Stefan Denda, MSc, Research Assistant, Geographical Institute "Jovan Cvijić", Serbian Academy of Sciences and Arts, Djure Jakšića 9, 11000 Belgrade, Serbia, s.denda@gi.sanu.ac.rs, +381 11 2636594

will not visit destination again, nor recommend it to their friend and family.

Forest fires are a natural disaster that can pose a significant problem for the tourism industry. However, according to widely accepted views, the vast majority (generally considered over 90%) of forest fires are caused by humans. On the other hand, appropriate natural conditions are required for the spread of fires. These conditions directly determine the intensity of fire and the damage they cause. It is clear that humans, besides causing fires, shape the natural environment, thus creating more or less favorable conditions for the occurrence and spread of fires. The causes of forest fires will be discussed in this paper, first and foremost about new knowledge that natural factors are far more important than previously thought.

Nowadays, the term "forest fires" is commonplace, regardless of which vegetation cover is affected. Thus, fires of grass, shrubs and even some crops are considered forest fires. Fires occurring in forested areas that affect only grass and shrub cover and are still considered forest fires. In this sense, the term "vegetation fires" would be much more appropriate. The term "wildfires", which refers to uncontrolled spreading fire, also covers different types of vegetation. Nevertheless, the term "forest fires" is mainly used in this paper, primarily because it is widely accepted.

This study analyzes the problem of forest fires in European tourism. Examples are given primarily for the most vulnerable countries: Portugal, Spain, France, Italy and Greece (San-Miguel-Ayanz et al., 2019). In the case of the aforementioned countries, the tourist season and the fire season are in the same period (May-October, and especially July-September).

The aim of this paper is to point out the problem of forest fires in tourism, as well as to give a review of the most significant events in which human casualties were recorded. Trends in the number of fires and the size of the area burnt were also analyzed. The possibilities for improving the situation, i.e. fire protection, were analyzed separately. In this regard, special importance was given to the fire forecast, based on which warnings and evacuations should be issued.

Material and methods

The official forest fire data for the period 1980-2018 (San-Miguel-Ayanz et al., 2019) were used in the research. Data included the annual number of fires and the total annual burned area in European countries. In the case of major fires which represent environmental disasters, field reports were also used.

Linear trends were determined for the data. The statistical significance of linear trends was determined for (n-2) and based on the coefficient of determination (R^2). For the testing of the significance t-test was used:

$$t = R\sqrt{\frac{n-2}{1-R^2}}$$

(n is the length of the series). Statistical significance was tested at $p \leq 0.05$ and $p \leq 0.01$.

Results and discussion

According to San-Miguel-Ayanz et al. (2019), in the period 1980-2018 in the five EU countries that suffered the most from forest fires (Portugal, Spain, France, Italy, and Greece), 1,858,595 fires were recorded (47,656 anually on average). The total burned area was 1,748,6940 ha (174,869.4 km2), i.e. an average of 448,383 ha (4,483.83 km2) anually. The largest part of the data presented relates to the summer period when it is also the main tourist season.

Out of the five countries mentioned, Portugal may be considered the most vulnerable to forest fires. During the studied period, an average of 18,025 fires was recorded anually, with an average annual burned area of 116,894 ha. The largest damage was recorded in 2017, when 540,630 ha were burned, which is about 5.9% of the state territory. Major damage was also recorded in 2003 (425,726 ha) and 2005 (338,262 ha). In the investigated period, there was a non-significant increasing trend of the annual burned area, while the increase in the number of fires was statistically significant ($p \leq 0.01$). The fires in the summer of 2003 killed 18 people, while in the period 17-24 June 2017, 66 casualties were recorded (over 100 in some reports).

In Spain, an average of 14,566 fires was recorded anually, while the average area burned was 158,834 ha. There was a non-significant increasing trend in the number of forest fires, while in the case of a burned area there was a decreasing trend (statistically significant at $p \leq 0.01$). Fires in Guadalajara province (central Spain) in 2005 killed 11 firefighters. In August 2019, fires struck the Canary Islands and majority of them were under smoke, which was also recorded in satellite images.

France, compared to Spain, and Portugal in particular, is less threatened by forest fires. Although the largest of the countries surveyed, there was an average of 4,663 fires per year, while the average annual burned area was 24,200 ha. The trend of the number of fires is decreasing and it is significant at $p \leq 0.05$. The trend of the burned area is also decreasing, but significant at $p \leq 0.01$.

Italy is also less vulnerable to forest fires compared to Portugal and Spain. An average of 8,970 fires occurs anually, with an average annual burned area of 105,104 ha. In Italy, there is a downward trend in the number of fires and burned area (statistically significant at $p \leq 0.01$).

In Greece, there is an average of 1,432 fires per year, with an average annual burned area of 43,351 ha. The trends are downward in both cases and are not statistically significant. In the period 23-26 July 2018, in the Attica region fires 102

casualties were recorded. Summer fires in tourist zones have occurred in Greece before. At the end of July 2007, there were a number of fires not only in Greece but also in other Balkan Peninsula countries (Serbia, North Macedonia, Albania, and Bulgaria). Interestingly, these fires were preceded by fires in northern Africa. On that occasion, there were numerous fires in Algerian forests close to the Mediterranean Sea.

Tourism in the Mediterranean area is based on diverse natural and cultural resources that could be threatened by wildfires in these forests. Besides major tourist flows towards the Mediterranean coincide with the fire season, so these events could lead to negative social, environmental, and economic implications in these destinations (Boustras & Boukas, 2013).

It is important to note that in the Mediterranean area, natural conditions are particularly conducive to the occurrence and spread of fires. The most important factors are dry periods in summer, dry terrain and vegetation that is extremely vulnerable to fire. Evergreen shrubby Mediterranean vegetation (macchia) forms dense formations that burn easily and quickly. Among the forest trees, the area is dominated by pines, which are extremely vulnerable to fire. The most widespread pine species in most of the Mediterranean area is Aleppo pine (Pinus halepensis). Therefore, Mediterranean vegetation, which contributes to the beauty of the countryside, in this case, is a fire risk factor. It is also important to point out that in Portugal, the presence of eucalyptus plantations increases the risk of fire. These species have been introduced from Australia.

As for the countries of Central, Northern, and Eastern Europe, they are less vulnerable to fire compared to the Mediterranean countries. Therefore, the tourism industry also suffers far less damage.

Central European countries are characterized by two fire maximums during the year. In addition to the summer maximum, there is also a maximum that occurs in late winter and early spring. This is the time before the beginning of the growing season when there is dry grass cover from the previous year. As far as northern Europe is concerned, Finland is an example of a country slightly threatened by forest fires (Milenković et al., 2019).

Overall, much of Europe is characterized by conditions that cannot be considered particularly suitable for the occurrence and spread of fires. This primarily refers to the presence of surface water and the composition of vegetation.

As for forest fires in Serbia, they pose a problem, but certainly not as pronounced as fires in the Mediterranean area. The most endangered area is the Deliblato Sands, with several conditions suitable for the occurrence and spread of fires. These are sandy soil that allows water to flow into the lower layers, vegetation composition (presence of pines), as well as relief that does not impede the spread of

fires (Milenković et al., 2018). According to the data from the archive of Public Company "Vojvodinašume" from Novi Sad, in the period from 1948 to the present day about 267 fires have been recorded in Deliblato Sands, while the total burned area was about 12,000 ha. About half of this was burned in the four largest forest fires ever recorded in this area (Milenković et al., 2018). If only the burned area under the forest is observed, these four fires account for about two-thirds. According to Gomes et al. (2009) and Milenković et al. (2011), the largest forest fires in the recent history of the Deliblato Sands were caused by the activity of the sun (solar wind).

According to this hypothesis, large forest fires are caused by high-energy solar wind particles originating from active regions and coronal holes. After breaking through the Earth's magnetic shield, these particles can reach the surface of our planet and cause fires of vegetation cover. The hypothesis has been confirmed in the cases tested so far (USA, Portugal, Greece, etc.) (Gomes & Radovanović, 2008; Radovanović et al., 2015a; Radovanović et al., 2015b). This knowledge should be used to improve fire protection, primarily forest fire forecasting, which is currently based on weather data.

The wildfires in the forests have an immense impact on the tourism industry. First of all, it could threaten the lives of local citizens and tourists, and very often they need to be evacuated. Other implications refer to the damage of tourism infrastructure and suprastructure and compromising the image of the destination, which could lead to disruption of tourism activities (Boustras & Boukas, 2013). During the fire-fighting time, an important issue for the tourism industry is the media coverage and their sensationalism in the news creation, which further can worsen the tourists' risk perception. Even if the news is true, thanks to sensational headlines, they can dissuade tourists from visiting a wider region than the truly endangered one (Murphy & Bayley, 1989).

Conclusion

Forest fires can be caused by humans and the nature forces. No matter how they came into being, they pose a threat to the tourism industry. In addition to the threat they pose to human lives, they also threat tourism infrastructure and suprastructure and make a bad public image of the tourist destination. In Europe, the largest problems with forest fires occur in Portugal, Spain, France, Italy and Greece, countries with developed tourism industry. Statistically significant ($p \leq 0.01$) downward trends were found for Spain (burned area), France (burned area) and Italy (both parameters), while a statistically significant ($p \leq 0.01$) increasing trend was determined only for the number of fires in Portugal. A particular problem is the fact that in these countries the major tourist and fire seasons almost coincide. In the future, special attention should be paid to fire protection in terms of improving the prognosis of forest fires.

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